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From Efficiency-Driven to Innovation-Driven Economic Growth: Perspectives from Singapore*

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ABSTRACT

This paper looks at Singapore's efforts to transform the economic growth base from one that is predominantly efficiency driven to one that is more innovation driven. To accelerate the transition process, the government is aggressively investing in "innovation infrastructure" systems and institutions that make the city a more conducive environment for innovations. The modus operandi, with a distinctive "winner-picking" flavor, mirrors that of its earlier strategic industrial policy in building up the manufacturing sector. It is also in sync with the new urban growth literature, which argues that the success of any innovation-driven growth strategy depends on a city's ability to attract a large community of creative individuals in different fields.

Innovation infrastructure building requires more than putting in the right systems. It also requires a mindset change at various levels of society. This paper looks at how the government's policy philosophy and practices have evolved over time, and discusses the effectiveness of the government-led, strategic supply-push approach in propelling Singapore onto an innovation-driven growth path. It takes into consideration the city-state's underlying comparative advantages (or disadvantages) and asks how Singapore's existing strength in efficiency infrastructure may give it a first mover advantage in attracting creative talents, how its success may be affected by the small size of the economy, and the various political and social constraints that a small sovereign city-state faces. These issues are explored against the backdrop of the keen competition among the major cities in the region to become an innovation hub.

I. Introduction

The Singapore economy is going through a period of major restructuring. Economic stagnation since the 1997 Asia financial crisis (except for a brief recovery in 1999) has called into question the continued relevance of many fundamental policies that had worked well in the past. In 2002, a high-level Economic Review Committee (ERC) was convened by the government to chart new directions for the economy. A common thread that ran through the committee's various reports was a call to enhance the economy's innovative capacity, with the aim of making Singapore an innovation hub in the region.[2] The call reflects an increased awareness both within and outside the government of the need to redefine Singapore's comparative advantage through a new national innovation policy.

Traditionally, Singapore has billed itself as an "efficient" business city. The ability to provide quality infrastructure services more efficiently than the neighboring countries has long given the city-state a comparative advantage in the manufacturing sector.[3] Such efficiency, together with a relatively corrupt-free civil service[4] and a highly educated and English-speaking workforce, made Singapore a choice production base for multinational corporations (MNCs), which played a pivotal role in the success of the country's industrialization program in the past. The "efficiency premium" also allows the country to leverage its strategic geographical location to serve as the commercial hub of the region.

Singapore is however facing mounting challenges in maintaining its "efficiency premium". Other Asian countries are fast catching up on the provision of quality infrastructure. Even Singapore's status as the premium air and seaport in the region – an area where the city's leading position was previously thought to be unassailable – has come under tremendous competitive pressure.[5] At the same time, business operating costs, including land costs, do not

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[2] See ERC Main Report, 2003.

[3] An oft-quoted example of such efficiency is that a foreign visitor arriving at the Changi International Airport generally takes less than 30 minutes to a downtown hotel (including customs clearing).

[4] In the latest World Competitiveness Report (2002/2003), for example, Singapore ranks top (i.e. least negative) in areas like "favoritism in decision making of government officials", "transparency of government policy-making", "burden of regulation" etc.

[5] The challenge to the seaport hub status is reflected in the relocation of operational headquarter by two major shipping companies, Evergreen and Mersk, to Tanjong Pelapas port in the neighboring Malaysian state of Johor in 2002. The move sparked major changes in the Port of Singapore Authority (PSA). See section V for more details.

appear to have adjusted fast enough to reflect the narrowing gap in infrastructure quality.[6] Compounding the problem is the global trend of increased commoditization of many manufacturing products made possible by technological advances, which favor countries with low operating costs. These developments have led economists to conclude that, to remain internationally competitive, the Singapore economy has to be more innovative, with the capability to develop its own brands of goods and services. Efficiency alone will not guarantee sustained robust growth in the future.[7]

Debates on creativity and innovation are not new in Singapore, although the strategic focus has shifted over the years. Krugman (1994) and Young (1992, 1995), for example, questioned the basis and sustainability of Singapore's economic growth in a series of studies as far back as the early 1990s. Pointing to the low contribution of total factor productivity (TFP) growth, Krugman referred to the Singapore miracle as having been based on "perspiration rather than inspiration": "Singapore grew through a mobilization of resources that would have done Stalin proud…. All of Singapore's growth can be explained by increases in measured inputs. There is no sign of increased efficiency."

While disputing such views,[8] the Singapore government has since set aside more resources to promote R&D and innovation. Among the more visible efforts were the various five-year plans laid out by the National Science and Technology Board (NSTB), starting from the early 1990s. These efforts were however targeted mainly (and narrowly) at short-term, applied technological innovations, with few attempts to deepen the culture and practice of innovation across the whole economy.

Success stories have been sporadic so far. As Wong (2003) observed, "While Singapore's technology deployment capabilities (to operate and adapt technologies) are now close to the world frontier, its capability to create technologies (to innovate and pioneer new technologies) is still lagging considerably behind this frontier."[9]

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[6] The government has over the past year begun to tackle the labor cost by reducing the compulsory contribution rates to the pension funds by employers and to inject more flexibility into the wage setting system. However, it is a lot more cautious in its moves to reduce the land costs for fear of sparking a severe plunge in the property markets.

[7] See various studies on this issue by the World Bank, including Yusuf et al, 2003.

[8] See Rao and Lee, 1996 for various views on this issue.

[9] See Wong, 2003, page 12. As an indication of Singapore's technology deployment capabilities, the World Economic Forum Global Competitiveness Report 2001-2002 ranks Singapore top in networked readiness. In the area of telecommunications connectivity, besides a nationwide broadband network infrastructure, Singapore has 21 Tbps of installed international capacity, sufficient for `every business need'. See www.one-north.com.

In the latest Global Competitiveness Report, for instance, Singapore was ranked 25th in terms of firm-level innovation in 2002, way below most developed economies at a similar level of per capita GDP.[10] Singapore ranked highly (top 5-10 in the world) in terms of technology-using indicators such as quality of school science and technology education, licensing of foreign technologies etc, but was rated much lower in technology-creating indicators like R&D spending, R&D personnel, availability of venture capital and intellectual property protection (10th-17th in the world). At the same time, Singapore ranks poorly in terms of entrepreneurial activities. In the 2003 Global Entrepreneurship Monitor studies, Singapore ranked 21st among the 31 countries surveyed in total entrepreneurial activity. Within the subset of 22 OECD/East Asian countries, Singapore stood at a dismal 15th.[11]

A new strategy to develop Singapore's comparative advantage in innovation began to emerge from 2000. The central element of the new policy is the holistic approach it assumes. In addition to applied, technological innovations in the manufacturing sector, there is now also a strong emphasis on innovation in the services sector, including the "creative industries"[12] and entrepreneurial activities. Moreover, policy incentives are extended not only to big firms, but also small and start-up companies. Supporting infrastructure, both physical and institutional, are being developed in this connection. There are also efforts to change the "mindset" of Singaporeans, to bring out the enterprising and adventurous spirit in them. In short, the new strategy calls for an aggressive build-up of what some economists call "innovation infrastructure" (as opposed to "efficiency infrastructure").[13] The new strategy reflects the city's ambition to redefine its "premium" over other economies in terms of innovation rather than efficiency.

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[10] See World Economic Forum, 2002.

[11] See Wong, 2004a.

[12] Broadly speaking, these are industries which have their origins in individual creativity, skill and talent and which has a potential for wealth and job creation through the generation and exploitation of intellectual property. The innovations could come from the high-tech and biotech fields, they could also be found in more artistic fields such as music, film, book writing, etc. What they have in common is that most of them come under the purview of IP laws, and it is the use of IP laws that helps unleash the full economic value of the innovations (see Howkins, 2001).

[13] The terms are used to highlight the different natures of the two types of infrastructure. Efficiency infrastructure refers to facilities that help improve the efficient running of the economy such as public service, transportation system, telecom system, business friendly regulation, good corporate governance, low tax rates etc. "Innovation infrastructure" on the other hand refers to those that help make a city conducive for innovation activities. This includes things like R&D facilities, venture capital availability, well defined IP laws, and amenities that can help to attract creative talents. The latter include physical recreational amenities, public space, cultural districts etc, as well as "softer" infrastructure like a more open culture with high tolerance for different lifestyle choices and encouragement for diversity and non-conformist thinking. See Yusuf, at el, 2003.

Competition from other dynamic East Asian economies is adding to the pressure to change in Singapore. Like Singapore, these economies are also looking for ways to enhance their own innovative capacity. Statements from Singapore officials often reflect worries that the region may not be able to support more than one major innovation hub and that the island state may lose out if it does not respond in time and effectively to the competition.[14]

In this paper, we shall try to put in perspective Singapore's efforts to transform the city-state from an efficient economy to an innovative economy. A basic question here is: Does an innovative economy require a very different set of supporting infrastructure from an efficient economy? If so, has the government made the necessary changes to facilitate the transition? More generally, one may ask whether there is a contradiction between Singapore's twin objectives of becoming an innovation hub and sustaining its status as one of the world's most efficient cities for businesses. The issues will be discussed within the context of the competition posed by other dynamic East Asian economies. The paper will draw on information gathered from interviews with individuals working in innovation-related fields. These include policy makers, intellectual property lawyers, participants within the creative industries, foreign chamber of commerce representatives, opinion makers, etc.

The paper is organized as follows. The next section summarizes the essential ingredients that were put in place to enhance business efficiency in Singapore since its independence. In section III, we look at the rationale behind the re-orientation of the innovation policy in the past few years. Section IV describes the various measures that have been implemented in the past few years to facilitate the transition to an innovative economy. Section V discusses Singapore's comparative advantage in the innovation businesses, taking into account the constraints it faces as a small sovereign city-state. Section VI turns to the country's efforts to enhance efficiency in its services sector. The last section summarizes by taking a critical look at the effectiveness of Singapore's modus operandi and considering some alternative growth strategies.

II. The Quest for Business Efficiency

Singapore is a densely populated city-state with 4.2 million people and a land area of only 685 square km. A British colony for many years, Singapore attained self-government in 1959, joined Malaysia in 1963 and became an independent city-state in 1965. The People's

[14] See for example, ERC Main Report, 2003, report by the Services Sector Sub-committee.

Action Party that was elected in 1959 has since been returned to power at every election. During the politically turbulent 1960s, the government concentrated on issues of employment creation and housing provision and Singapore's efforts at attracting foreign investment in labor intensive industries met with great success.

Today, there are over 5,000 foreign companies located in Singapore and many multinational corporations and foreign financial institutions have established regional operating and manufacturing bases on the island. Full employment was achieved by the early 1970s. Between 1966 and 1990, the Singaporean economy grew at 8.5% per annum. The per capita income grew at 6.6%, roughly doubling every decade. The World Development Report 1998 estimated that Singapore's 1997 GNP per capita of US$32,940 (based on purchasing power parity) was the fourth highest in the world (after Switzerland, Japan and Norway). Over the years, the economy has also gradually moved up the technological level. Many labor intensive industries like textiles are no longer an important part of the economic landscape in Singapore. The impressive growth momentum was only halted after the 1997 Asia economic crisis. A sharp decline in growth rates together with a depreciation of the Singapore dollar brought the country's per capita GNP in 2002 down to US$20,690 (on a PPP basis), making it only the 17th highest in the world.[15]

A stable, farsighted, and uncorrupt government, which adopted proactive growth strategies, has long been credited as one of the main factors behind the success of the Singapore economy in the pre-Asia crisis period. To attract mobile capital and talent, the government has tried to ensure that immobile factors such as infrastructure facilities and system management complement growth. The key concern for the government has always been "efficiency". Indeed, it has been recognized right from the beginning that, to compensate for the natural "comparative disadvantage" associated with a small economy with a limited domestic market and population size, Singapore will have to develop a highly efficient and productive infrastructure system to help reduce production cost and attract foreign investors.

The results of such a drive for efficiency are widely recognized. The IMD World Competitiveness Scoreboard 2002, for example, ranked Singapore as the fifth most competitive country in the world, based on factors such as economic performance, government efficiency,

[15] See World Development Report 2004.

business efficiency and infrastructure. During the previous four years Singapore was ranked in second place.

This section summarizes the essential ingredients that have been put in place to promote Singapore as an "efficient business centre". The following sectors/areas will be briefly covered: land use and planning, transport and logistics, energy and water, telecoms and internet connectivity, education and labor policies.

Land use and planning

Land is a scarce resource, the allocation of which is subject to meticulous planning and management in Singapore. The government owns more that 80 percent of land in Singapore through a process of land reclamation, and eminent domain provisions that made it easy and cheap for the government to acquire private land for development purposes (Phang, 1996). Land use planning has been effected by the Urban Redevelopment Authority through the Concept Plan and Master Plan.

To facilitate foreign direct investment in manufacturing, the Economic Development Board (EDB), and later the Jurong Town Corporation (JTC), developed industrial sites and science and business parks on state-owned land at various locations throughout the island. Epitomizing the Singapore approach to industrial development is Jurong Island, managed by the JTC. The island is a chemical hub that houses the petrochemical cluster and has been created through large-scale land reclamation from an initial group of seven small islands. The island is linked to the mainland by a 2.6 km causeway. When reclamation works are completed in 2005, the size of the island is expected to be about 3,200 ha, which is three times the total size of the original group of seven islands. Jurong Island embodies the government's industry cluster strategy, where industrial policy is targeted not at the level of individual industries, but at industry clusters, so as to reap the positive network externality effects.

Concurrent with industrial space and infrastructure provision, the Housing and Development Board (HDB) provided affordable public housing for rental and sale (99 year leases). The public housing sector grew eventually to accommodate 86 percent of the resident population. There is an active secondary market for owner occupied public housing which facilitates household mobility subject to minimum occupancy periods. The overall homeownership rate is 92 percent. A competitive bidding system is used to allocate state land to

the private sector. State land leases, which typically run for 99 years or less, direct private real estate development toward state determined priorities such as the financial district, new private housing, renewal of specific industrial estates etc.

Transport and logistics

Historically, Singapore was developed as a major port, the commercial hub of a rich primary resource producing region, and the administrative capital and garrison of the British Empire in Southeast Asia. Entrepot business played a prominent role in the economic life in Singapore before independence. While manufacturing and financial and business services have become the drivers of economic growth in independent Singapore, the development and sustenance of the transportation hub has not been neglected. Transport and logistics plays a key role in defining business efficiency in Singapore, and in maximizing Singapore's connectivity as a strategic node for global companies serving the region.

Singapore's port has grown to become one of the world's busiest in terms of shipping tonnage, especially in container handling and bunkering facilities. Changi Airport in 2002 handled 29 million passengers, 1.64 million tonnes of cargo and 174,820 aircraft movements. With the scheduled completion of the third passenger terminal in early 2008, the airport will have the capacity to serve 64 million passengers a year. (Both port and airport ownership and operations are not privatized.)

Urban productivity is highly dependent on the efficiency of its transport system, to move labor, consumers and freight between various origins and destinations. Unlike many other cities which have face a wide array of urban transportation problems, Singapore has managed to successfully control its car population through a combination of heavy taxes and charges. Traffic congestion is contained through an elaborate motor vehicle quota scheme (which serves as a significant revenue source) and electronic road pricing which keeps traffic generally free-flowing in the CBD and on expressways and main arterial roads. To help build a `world class land transport system', the government completely subsidizes the capital cost for construction of the rail network. Public transport services (both bus and rail) are provided by two private multi-modal transit companies and regulated by the Public Transport Council.

Telecoms and internet connectivity

Apart from physical infrastructure development, the government has also implemented policies to develop an information communications sector and has aspirations for Singapore to be the information hub for the region. The state owned monopoly, Singapore Telecoms, was partially privatized through listing on the stock exchange in 1993 to help realize greater efficiency. Market liberalization and a pro-competition framework were established, with regulatory functions performed by the InfoComm Development Authority (IDA). Competition has lowered prices and spurred demand in the telecoms sector. As of September 2003, the mobile phone penetration rate in Singapore had reached 82%, the highest in Asia.

The Singapore ONE project, launched by the government in 1998, provides broadband infrastructure of high capacity networks and switches, with the goal of making broadband access available to 99% of the population. Between 2000 and 2002, the household and corporate broadband penetration rates grew from 8% to 24 % and 15% to 41%, respectively. By June 2003, the household broadband penetration rate had increased to 31%, in step with the IDA's target of 50% by 2006.

The Singapore government is also one of the earliest in the world to implement the e-government system. The IT2000 Masterplan provided a blueprint for the use of IT in nearly every government department. The Ge-BIZ portal on the e-government site was the world's first Internet-based government procurement system. At the eCitizen centre, Singaporeans obtain information and bid for certificates to register a vehicle, file their taxes, download forms to file for bankruptcy, register a marriage, baby, car or a pet, apply for a passport, housing or utilities, check their provident fund accounts or their child's school registration status, etc.[16]

Energy and water

Despite being devoid of energy resources and dependent on neighboring Malaysia for half of its daily water needs, disruption of utilities supply is a rare occurrence in Singapore. The electricity and piped gas industries had traditionally been vertically integrated and government-owned, managed by the Public Utilities Board (PUB). In 1995, the various undertakings of the

[16] In its 22 June 2000 edition, the Economist magazine remarked, "When it comes to e-government, there is nothing to match Singapore". In the annual survey by consultancy firm Accenture, Singapore has retained its position as having the second best e-government service in the world for 4 consecutive years starting from 1999, after Canada.

PUB were unbundled and corporatized. In 2001, a new statutory board, the Energy Market Authority was established to regulate the electricity and gas industries as well as operate the electricity system. Its subsidiary company Energy Market Company Pte Ltd operates the wholesale electricity market. There are at present seven generation licensees and seven retail licensees.

Singapore relies on Malaysia for supply of more than half of its water consumption each day. The two water treaties with Malaysia date back to the early 1960s and were part of the dissolution terms agreed at the separation of the two countries in 1965. The terms of the agreement, in particular the price of raw water (3 Malaysia sen per 1,000 gallons or 4,550 liters), have been a key irritation in the bilateral relations for years. In a bid to demonstrate that it can be self-sufficient in water, the PUB has embarked on water recycling on a limited scale (`newater' has been introduced into reservoirs since early 2003), a desalination plant project, as well as building an elaborate drainage system to capture rain water.

Education and labor

Education is highly subsidized and constitutes the second largest item of government expenditure (after defense). The percentage of students enrolled in a local university has increased markedly from 7.7 percent of each cohort in 1985 to 21% percent in 2002. The government's plans are for 25 percent of each cohort to be able to enjoy the benefits of university education. Manpower planning is effected through detailed quotas on the number of students to be admitted to specific programs (law, medicine, architecture, civil engineering, computer engineering, etc) at the tertiary institutions. A new agency, the Singapore Workforce Development Agency was established in 2003 with the specific purpose of enhancing workforce skills through `developing a comprehensive, market-driven and performance-based adult continuing education and training framework' (Ministry of Manpower website).

While there are no official statistics for the foreign component of the workforce, the population data reveals that 19% of the 4.17 million people in Singapore are foreigners. Indeed, given the small population base in Singapore, it has always relied on foreigners to perform various jobs in the economy. Since the late 1990s, as part of its move to build up the innovative economy, it has also embarked on an aggressive "foreign talent" policy, to attract foreigners who possess the necessary skills for innovation-related, high value-added work. As the Ministry of

Education noted, "Singapore wants to attract foreign talent at all levels of society – from CEOs to professionals to skilled workers – to work here. It wants to be a cosmopolitan, global city, an open society where people from many lands can feel at home".[17] The Ministry of Trade and Industry has estimated that 37% of the economic growth in Singapore in the 1990s was due to the influx of International Talent.[18]).

III. New Orientation of Innovation Policy

In his book on "Free Market Innovation Machine", Baumol (2002) observes that innovation is derived from both the routine activities of giant firms and from independent inventors and their entrepreneur partners. The necessary conditions or determinants of innovation may be analyzed at two levels: the determinants of organizational innovation over which firms have control (the internal environment), and the external social/business/regulatory environment within which firms and individuals operate. Factors at both levels are likely to determine innovation in giant firms, while the social/business/regulatory factors alone determine the extent of entrepreneurial activity. The two activities are not substitutes. Rather, entrepreneurs provide the more heterodox, breakthrough innovations, and the R&D establishments of the larger firms often enhance and add value to those breakthroughs by improving on them.

Traditionally, researchers and policymakers have focused their attention on industrial innovation. Service sector innovations and innovation within the creative industries have been relatively neglected until recently. To be sure, there is no clear dividing line among the various types of innovations here. Quite often, industrial product innovations (e.g internet hardware) serve as an initial catalyst for innovation in the services sector and in the creative content industries (e.g e-business); subsequent innovations in all sectors then interact and cross-fertilize with each other to trigger further innovations. Such overlaps notwithstanding, the table below is a convenient way of classifying the sources of innovation in an economy.[19]

Table 1 Sources of innovation (examples)

[17] See Singapore Ministry of Education website.
[18] See the Ministry of Trade and Industry website, http://www.sif.org.sg/shanghai_conf/docs/Mike_Gray.doc
[19] Appendix A provides an overview of the various views on what makes a company conducive for innovation. It looks at both the internal and the external conditions that are considered important for innovations.

	High-Tech Manufacturing Sector	Services Sector (Incl. Knowledge Intensive Business, KIB)	Creative Content Industries
Giant firms	GlaxoSmithKline	Citibank	Disney
Entrepreneurial	Garage inventors	Dot-coms	Fashion designers

Table 1 provides the context for our discussion on the changing philosophy in Singapore's innovation policy. Until the late 1990s, the policy was concerned mainly with the top left box of the table i.e. high tech manufacturing innovation in giant firms. Most of the policy incentives were targeted at large MNCs or large government-linked-companies (GLCs) in the manufacturing sector. There were sporadic attempts to promote innovation in selected industries in the services sector, but mainly at the giant firm level.

The new policy that emerged from the turn of the century has taken a decidedly broader approach to innovation. It aims not only to promote innovations in all the three sectors above (manufacturing, services and creative content), but also to do so at different levels of firm size, from giant MNCs to local small and medium enterprises. In effect, the new policy aims to be exhaustive and cover all the boxes in the Table 1. Even within the high-tech manufacturing sector, there is a change in policy orientation. Under its first two five-year plans (1990-1995; 1996-2000), for example, the NSTB was concerned mainly with using and improving on technology developed outside the country, focusing on short-term, incremental, applied R&D. In the latest five-year plan (2001-2005), however, the thrust has shifted to "creating" technology. More resources are channeled towards long term, basic research. The NSTB also assumes a new mandate of building up the infrastructure and manpower needed to meet the challenges of basic research programs, especially in selected industries such as life sciences – a role similar to that of the National Science Foundation (NSF) in the US.

Though not officially articulated, the change in the innovation policy may have been influenced by a number of factors. Firstly, there is increased awareness that a significant part of innovation actually comes from small firms. The "dot-com" fever of the late 1990s had a bearing on the government's view of the likely sources of innovation and productivity growth in the economy. The fever spawned a large number of "e-commerce" type businesses in Singapore. Although many of them eventually failed, the episode nevertheless showed that there is an entrepreneurial and creative streak in smaller Singapore companies, provided the environment is conducive.

Secondly, there is greater recognition of the untapped innovative energy within the services sector which, if unleashed, could be a powerful force for productivity growth. Promoting Singapore as a service industry hub in Asia, through greater creativity and innovation, now constitutes a major plank in the country's new economic blue-print. In addition to traditional service industries that thrive in Singapore such as financial, tourism, entrepot trade, healthcare, transport and logistics, the government is also actively promoting the country as a regional hub in other service industries like education, legal services and creative industries.

Thirdly, there appears to be greater recognition of the positive externalities that creative content industries can generate in the economy, in addition to their direct economic contributions.[20] For example, the presence of a large artistic community is now valued not only for its direct economic contribution arising from the production of artistic works, but also for the positive role it plays in helping to make the city a more attractive living environment for innovative individuals in other sectors (e.g. high-tech manufacturing and other service industries). Implicit in this view is the argument that to be a successful innovative hub, a city must be able to leverage on the cross-fertilization of creative minds from various industries.[21] As the ERC report noted, "Throughout history, practitioners of different forms of creativity have tended to congregate and feed off each other in teeming, multifaceted creative centers – Florence in the early Renaissance; Vienna in the late 1800s and early 1900s; and the many fast growing creative centers across the US today such as San Francisco and Boston" (ERC report, 2002, Chapter 1, pg 1). [22]

In this regard, the policy appears to be in sync with the recent literature linking urban development policy and creativity and innovation, typified by the work of writers such as Richard Florida (2002).[23] This new strand of urban growth literature views creative workers as the engine of economic growth but with demanding work and lifestyle preferences and are attracted to live in cities that are "tolerant, diverse and open to creativity". Attracting these

[20] In many developed countries, the artistic and cultural industries are growing at a much faster rate than the overall economy. They also make up a significant portion of the GDP e.g. 7.75% for the US and 5% for the UK. In Singapore, creative industries account for less than 3% of GDP which points to large untapped potential. See ERC Report, 2002.

[21] See for example, speech by Lee Boon Yang, Minister for Arts and Information, 2004.

[22] The official definition of creative industries is narrower than what we have employed here. Officially, they are defined as industries which have their origins in "individual creativity, skill and talent and which have the potential of wealth and job creation through the generation and exploitation of intellectual property". Specifically, they comprise three main groups: arts and culture, design and media.

[23] See Florida (2002) as well as Hawkins (2001), Caves (2000) etc.

workers and the businesses that seek these workers require governments and urban policymakers to ensure their towns are "open to diversity",[24] and invest in "lifestyle and cultural amenities" such as bike paths, rollerblading trails, music festivals and entertainment districts.

The availability of easy access to cultural and artistic performances, a vibrant intellectual environment, opportunity to interact with other creative people etc are said to rank high in creative workers' choice of residential locations. In addition, such individuals work best in an environment that allows for a high degree of freedom and flexibility, and are therefore attracted to cities/countries that are more tolerant of individuals' work and lifestyle choices, receptive to diversity of views and willing to embrace new ideas. Most established creative hubs in the world like New York, London, San Francisco etc are indeed noted for such lifestyle attractions. Building an innovative environment accordingly goes beyond costs and constructing physical infrastructures. Policy makers must possess a certain mindset that allows them to empathize with the needs and preferences of the creative individuals.

Just like what it did in its pursuit of an industrialization program in the past, Singapore is adopting an aggressive "supply-push" strategy in its attempt to transform the city into an innovation hub. The government is investing heavily in infrastructure deemed necessary to building up a critical mass of innovative people and innovative activities. Through such investments, it hopes not only to achieve a "first mover advantage" that allows it to leapfrog the regional competitors, but also to generate certain "agglomeration effects" that help to ensure a continuous inflow of creative talents and sustain its regional hub status.

What distinguishes Singapore's current effort from the past policies is that it focuses on building innovation infrastructure, not just efficiency infrastructure; with the immediate objective of attracting the right type of workers rather than the right type of firms. Indeed, the infrastructure investment goes far beyond that of physical infrastructure. The government is also trying to increase the availability of innovation-enabling infrastructure such as R&D facilities, well-defined intellectual property laws, venture capital etc. In addition, there are wide ranging changes in education, social, immigration and other policies aimed at stimulating more creative pursuits by both Singaporeans and foreigners residing in the country.

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[24] Florida views the legalization of gay marriage as "one of the great talent attraction packages of the last hundred years" (as quoted in Malanga, 2004).

Various official statements highlight the strategic element in the government's "supply-push" approach. The ERC report on creative content industries, for example, likened the competition to "a war for creative talents and enterprises". It stressed that "Singapore has to compete vis-à-vis well established creative hubs of the world to attract and retain creative talents. Today, there are many anecdotal examples of 'creative brain drain' where our local creative talents venture overseas to develop their careers." The report specifically warned of the danger posed by other major cities such as Hong Kong, Shanghai and Seoul.[25]

IV. Current Policies to Build Up Innovation Infrastructure

This section highlights some of the more important initiatives in the economic, social and political spheres that have been launched over the past few years to facilitate the transition to an innovation-driven economy. Perhaps no other project expresses the new holistic policy philosophy more eloquently than One-North and Esplanade. Both projects embody the government's belief in building a "total innovative environment" in order to attract and retain creative talents. They also demonstrate the government's commitment to build up the necessary institutions and infrastructure to support the transition from an "efficient economy" to an "innovative economy". In addition, the focus of One-North captures the new emphasis on basic, long term industrial R&D, as opposed to short-term, applied R&D.

One-North Development[26]

Located within a 10 minute drive from the CBD, the S$15 billion (US$8.5 billion) development is envisaged to become a world class R&D hub for scientists and entrepreneurs working in three industries -- biomedical sciences, information technology (ICT) and media. The project, which was launched in December 2001, covers a land area of more than 200 hectares. It is expected to be completed in phases over a 15-20 year period. Phase I of the project will feature, among others, two centers of activities. The Biopolis will serve as the focal point for biomedical sciences R&D while the Fusionpolis will house collections of firms involved in R&D and production works for ICT and media industries. By focusing on the whole

[25] For example, Hong Kong plans to build a 40-ha integrated arts, culture and entertainment district at West Kowloon while Seoul has established the Korea Culture and Contents Agency and plans to develop a 565,000 sq m Seoul Digital Media City. See ERC report 2002.

[26] The development is so-named because Singapore is situated one degree north of the Equator.

chain of production activities, including a large portion of basic research, One North is deliberately differentiating itself from the two adjacent Science Parks (Science Parks I and II), which are oriented towards the more applied end of the research chain.

Designed as a "total living and working environment", One-North will comprise not only research institutes and business offices but also residential properties, shopping, public parks and other amenities. It will be equipped with state of the arts facilities in computing network, sewage disposal and energy generating systems. It will even have its own internal shuttle train system. The project claims to offer opportunity for "seamless interaction" among research scientists, entrepreneurs, and other business and services sector operators within an "enclave" environment, so as to exploit fully the "agglomeration" effects. The project's close proximity to other major tertiary institutions (e.g. National University of Singapore, INSEAD Asia campus) makes for easy collaboration with researchers outside.

The tenants of One-North comprise both public and private research institutions and business enterprises. The Genome Institute of Singapore and the Bioinformatics Institute were among the first to move into the Biopolis, which was the first center in One-North to start operations, in October 2003. This has been followed by other A*STAR biomedical research institutes like Bioprocessing Technology Institute, Institute of Bioengineering and Nanotechnology and the Institute of Molecular and Cell Biology. Private companies such as GlaxoSmithKline, Novartis Institute for Tropical Diseases and Vanda Pharmaceuticals and Paradigm Therepeutics have also signed up. Many of these firms intend to undertake a wide range of activities in Singapore, from basic research and development to product and process development, clinical research, manufacturing, business headquarters and healthcare delivery operations.[27]

When fully occupied, the seven buildings in Phase I of the Biopolis project will house about 2,000 researchers. Additional land has been set aside to allow for expansion to take in other private sector entities, with a community of about 4,000 researchers when the project is completed.

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[27] *GlaxoSmithKline*, which has so far *invested US$588 million* in Singapore, has intentions to expand its existing plant there by an *additional $59 million* to boost the pharmaceutical company's current investment, aimed at shoring up its production capability for drugs for asthma patients. The company also intends to build a *$29 million technology center* by next year to improve coordination between research and development (R&D) and manufacturing.

Fusionpolis, on the other hand, is expected to commence operations in the third quarter of 2005, when a S$500 million, two-tower-cum-podium complex is completed. It will be the focal point for researchers, content creators, financiers and other industry players in the info-communications, media and education sectors. The Media Development Authority (MDA) plans to attract and/or relocate companies across the entire media chain, from pre- to post-production, to Fusionpolis. Among the major clients that have agreed to set up operations in Fusionpolis is a consortium whose partners include the Economic Development Board and Lucasfilm Ltd, the entertainment company of George Lucas, the creator of blockbuster films such as "Star Wars" and "Raiders of the Lost Ark". The consortium will specialize in digital animation for films, television and video games. Lucasfilm cited strong intellectual property rules as the reason for picking Singapore over other Asian locations in its first overseas venture. [28]

Many of the researchers working in One-North will likely be foreigners. To overcome the shortage of scientists in Singapore, the government is actively recruiting from abroad. At the same time, it is providing generous funding for graduate studies in the local universities for a large number of foreign students. These recruitment efforts are supplemented by other incentives such as making it easy for their spouses to work in Singapore.

The Esplanade-Theatres on the Bay

Constructed at a cost of S$600 millions, the Esplanade is a world class, state of the art performing center located at the mouth of the Singapore River, right at the heart of downtown Singapore. With a 2000-seating capacity and one of the world's most acoustically meticulous concert halls, it is seen by some as a defining cultural edifice for a country that has hitherto been known largely for its economic success. The government clearly hopes that the project will help put Singapore on the map among the leading creative cities of the world. Since its opening in November 2002, Esplanade has staged a series of musical and theatrical performances by world renowned artists, providing some of the artistic entertainments that are available to residents in other creative hubs such as London and San Francisco. It reflects the government's belief that in

[28] Under the U.S.-Singapore Free Trade Agreement that took effect in January 2004, Singapore's intellectual property laws were harmonized with those of the United States. The Asian animation unit, which is looking to hire about 300 people for its Singapore operations, will focus on production work while the design and writing of scripts will continue to be done in the United States. Lucasfilm owns 75 percent of the venture, while a Singapore consortium led by the Economic Development Board holds the rest (http://money.cnn.com/).

order to attract world-class creative people, Singapore must be able to provide world-class artistic and cultural performances.

It remains to be seen how much direct economic spin-off the Esplanade will generate. Its main target audience so far has been domestic (which includes a high proportion of expatriates working in Singapore). Tourist dollars account for only about 10% of total ticket sales. At the same time, there are concerns that the massive funding requirement of Esplanade -- which has a yearly running cost of S$30 million, mostly paid for by government subsidy and corporate sponsorship – will choke off the sponsorship money for other artistic and cultural groups in Singapore, and retard rather than promote the performing arts in Singapore.

One-North and Esplanade may be the most visible symbols of Singapore's desire to become an innovation hub, but there are other important innovation infrastructures are also being built.

Intellectual Property Rights Laws

Protection of intellectual property rights (IPR) is one of the most important supporting infrastructures for individuals engaged in innovation work. Recognizing the long term benefits of having a stronger IP culture (in terms of its impact on innovation), a number of Asian countries are beginning to pay more serious attention to the enactment and enforcement of such laws. The proliferation of free trade areas in the region has also compelled many to set higher legislative standard in this area.

Singapore sees the need for a strong IP infrastructure not only to support innovation in the local economy but also to give the country a head-start in becoming the regional hub for IP management. Describing IP as "new gold of our time, waiting to be unearthed and exploited", the government has likened the development of the IP infrastructure as preparation to "join the gold rush".[29] What is needed is not only a set of well-defined and vigorously enforced IP laws, but also institutions that help keep Singapore at the forefront of IP knowledge.

To this end, the government upgraded the Registry of Trade Marks and Patents to a full statutory board called the Intellectual Property Office of Singapore (IPOS) in 2001. Besides being the lead government agency that formulates and regulates the entire range of IP legislations, IPOS has the mandate of "building an environment that promotes greater IP

[29] Speech by Ho Peng Kee, Senior Minister of State for Law, 11 September, 2002.

creation, protection and exploitation in Singapore". In addition, it is tasked to work with other government agencies including the EDB to develop Singapore's capability to support the IP activities in the region. Since its establishment, IPOS has been active in developing regional and global networks, including signing various bilateral and regional treaties (including US, EU and Japan), to help extend the reach of Singapore's IP community. In January 2003, IPOS also helped launch the Intellectual Property Academy, which has been mandated to help strengthen the IP competency in Singapore through research and education. The Academy is expected to play a crucial role in building up Singapore's position as a center for IP knowledge creation and management in the region. Further IP infrastructure development in the form of a specialized patents court and more favorable tax treatment for IP creators are also being considered.

Support for venture capital funds and entrepreneurial innovations

The important role that VC funds and angel investor networks plays in the success of the Silicon Valley has inspired many Asian countries to develop their own VC industry. In Singapore, government support has been a key feature of the VC industry development since its first days in the mid-1980s. The government was instrumental in setting up the early VC funds such as Vertex Management and EDB Ventures. In the late 1990s, it launched a US$1 billion Technopreneurship Investment Fund (TIF) to induce leading VCs in the world to use Singapore as the regional hub and to spur training for a core of VC professionals. There are currently more than 100 venture capital firms in Singapore. The aggregate funds under management totaled S$13.7 billion in 2001. About one-fifth of the capital had its origin in government funding.[30]

Given the importance that the government attaches to the development of entrepreneurship, it is likely to continue playing a strong supportive role in the growth of the VC industry in Singapore. The ERC report for example, recommended a slew of policy measures to help strengthen the industry further including harmonized tax incentives by different government agencies, increased deal flows for VC firms from spin-off of non-core assets by government-linked-companies etc.

[30] See Koh, 2003.

Educational and other research institutions

Research at the tertiary institutions forms an integral part of the innovation policy in any country. Over the past few years, there has been a marked shift in the orientation of the three local universities: from teaching to research. The third university, Singapore Management University, was in fact modeled on the research universities in the US. Funding for research programs and graduate studies has risen substantially, especially in selected areas such as life sciences, information technology, communications and management studies etc. Faculty evaluation is based increasingly on research output in reputable international journals.

There is also aggressive recruitment of research faculty from abroad and greater research collaboration with reputable universities outside Singapore. These changes are meant to propel the local universities into the league table of first class universities in the world, and to have them play a larger role in an innovation-driven economy. In 2004, the government announced plans to devolve greater operational and financial autonomy to the three universities and put in place a Quality Assurance Framework for Universities to track quality enhancement in the universities. In April 2004, University of New South Wales from Australia became the first private foreign university to set up operations in Singapore. The new university is expected to be a S$120 million venture with a capacity for 15,000 students.

Unlike many industrialized countries, however, key research institutions in Singapore, both in industrial and non-industrial fields, are still not parts of the universities. Though some of them may be located physically close to the universities, they are funded and managed separately. This is largely due to the fact that the universities are being administered by the Ministry of Education and the research institutes are usually sponsored by other statutory boards (to support their own objectives). The result, unfortunately, is that often research projects are sometimes not well coordinated and division of labor is not as efficient as it could otherwise be.

Changing the mindset

Many social commentators have long blamed the moribund state of entrepreneurship and creativity in Singapore on a highly paternalistic government and its tight control of political and social lives in the country. Too many rules and too harsh a stigmatization for non-conformist behaviors are said to have stifled Singaporeans' ability to innovate or even to think independently. Many have criticized the system for producing a whole generation of instruction

followers and managers but not enough enterprising spirit. The society's intolerance for failure is seen as a further hindrance to entrepreneurship.

As part of the efforts to encourage innovation, there have been some attempts in recent years to loosen up the regulatory environment and the government's grip on the social and political lives in Singapore. Committees were set up to identify areas where the government may be able to lighten rules and regulations so as to make it easier for individuals to start and operate businesses. Schools are revamping their curricula to inculcate a stronger entrepreneurial mindset in the students. Various public campaigns have been launched to raise awareness of the fruitfulness of entrepreneurial pursuits.

The Housing Development Board (HDB), for example, relaxed the rules in 2003 on the use of public housing apartment as office and commercial space – a change that is expected to help reduce the start-up costs for many small businesses. In the same year, the Urban Redevelopment Authority reversed a long standing rule in against street hawking (long seen as disorderly) by granting licenses for mobile food vans. Meanwhile, the Education Ministry is opening space for more private schools to operate in Singapore and relax the rules on inflow of foreign students (from primary school all the way to tertiary education level), so as to encourage more diversity in education and learning experiences. The entry criteria to the two local state universities have also been made more flexible to allow for a small portion of students to be admitted based on non-academic achievements. Other gestures of openness over the years include relaxation of rules on employment of gays in civil service, permission for bar-top dancing and bungee jumping, lifting of the ban on Cosmopolitan magazine (which was previously regarded as promoting "undesirable" lifestyles) and the idea of having a "bohemian" village in Singapore.[31]

Tapping on the resources of the Singaporean diaspora

Much has been made of the important role that Chinese diaspora plays in the development of the Chinese economy in recent years (and the Taiwanese economy in the 1970s and 1980s). These successful overseas Chinese are uniquely positioned to connect the Chinese economy with the global markets, and to capitalize on the different comparative advantages of China and their new homeland, be it the US, or European countries. Recognizing the potential

[31] See National day rally speeches by the Prime Minister Goh Chok Tong 2002 and 2003

contributions of the Singapore diaspora, the Singapore government has been actively promoting linkages with them in recent years.

In November 2002, the effort was formalized with the launch of "Majulah Connection" as a networking body for former Singaporeans. Though funded by the government, it was established as a private sector non-profit organization, to provide a business-orientated network for former Singaporeans living and working outside Singapore. It also operates as a link between these former Singaporeans and the Singapore officials, giving them a chance to participate in the formulation of policies in Singapore. They were for example, tapped for their inputs in the Economic Review Committee in 2002. Special "homecoming" events are organized for them to maintain their links with Singapore.

The size of the Singapore diaspora is small compared with that of the Chinese or the Indians. They are concentrated mostly in Australia and the US (especially the West coast). So far, they have not played any significant role in promoting business and investment in Singapore. Few have returned to start a business. It remains to be seen whether the setting up of a former networking body will make any difference to this.

V. Singapore's Comparative Advantage in Innovation Businesses

If Singapore's government-led, supply-push approach to innovation smacks of a heavy dose of strategic industrial policy, it is. Not only does the government fund the bulk of the investment in innovation infrastructure, it also takes a very strategic approach in deciding which specific industries to promote. "Picking winners" is very much a part of the strategy. This seems to go against the prevailing conventional wisdom in economics. Economists are generally skeptical about the effectiveness of strategic industrial policy precisely because it inevitably involves "winner-picking". Few governments in the world can boast a strong track record in picking winners. Neither has any of the more established innovative cities in the world gotten to where they are today through government-led strategies.

Singapore's embrace of the strategic industrial policy may be attributed to the successful deployment of similar policies in its industrialization programs in the 1970s and 1980s. The question is whether what worked in the past will continue to do so in future. The answer is not

immediately obvious given the differences between innovation activities and the more conventional industrial production activities discussed above. [32]

In building up the industrial clusters, Singapore was catering to the (known) requirements of the multinational corporations, exploiting the shift in production bases over the course of the product cycle. It was using existing technology without having to "push the frontiers". Innovation businesses, on the other hand, require considerable amount of frontier pushing and entail a great deal of uncertainty in terms of the ingredients needed to create the necessary and sufficient pre-conditions for success. The outcome of any government initiatives will naturally be much less predictable and the costs of the ventures potentially much greater.

In general, one may argue that industrial policy would be most effective when it is applied to strengthen a country's known comparative advantage, and that it should be avoided in areas where the country enjoys no natural comparative advantage. As things stand, Singapore is well recognized for its comparative advantage in two areas: its strategic geographical location (a given comparative advantage) and the strength of its efficiency infrastructure (a created comparative advantage). That the government is embarking on large scale construction of the innovation infrastructure reflects a serious effort to remedy one perceived weakness of the economy. There are two other major weaknesses that Singapore suffers as a small sovereign city-state economy: the limited size of the domestic market and the political and social constraints it faces in re-engineering the economy.

Wong et al (2004b) survey 40 firms in three segments (high-tech manufacturing, KIBs and creative contents) of the innovative sector. The results largely confirm the perceived strengths/weaknesses of Singapore as a potential innovative hub. For example, the two main reasons firms cited if they were to relocate away from Singapore are "market factors: other locations provide access to large emerging markets" and "more conducive business environment in other locations". At the same time, the main factors that keep the firms in Singapore are "the hub location", "strong business infrastructure" and "government support and incentives". For

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[32] Even in area where Singapore has succeeded, there was a certain element of luck involved. In a study on Singapore's investment in airport infrastructure, Phang (2003) argues that such an "over-investment" outcome would have resulted had the economy not grown more strongly than expected and the volume of world trade not exceeded the original official estimates. Strong growth in the region helped turn what could have been "over capacity" and wastage into an effective deterrence for other potential entrants to the market of air transportation and logistic services.

firms which decide to set up operations in Singapore, the main reason was "efficiency infrastructure" (second only to "home base" of key owners/management teams).

Can the development of the innovation infrastructure help overcome these other perceived weaknesses? The answer depends on which segment of the innovative sector we are referring to. The impact of the two constraints noted above (small domestic market and political/social constraints) varies among the three segments.

Size and Connectivity

In a study of the Silicon Valley phenomenon, Miller et al (2000) argued that it was not the size of the local market in the Bay area but the connectivity with the global economy that matters. The success of Singapore's past industrialization policy seems to reinforce such a view. But limited domestic market size may matter more for non-industrial, service industry type innovations than industrial innovations.

Consumer demand in the service sector, especially industries that relate to lifestyle preferences, often has a stronger local, cultural component. Physical proximity and cultural affinity with the consumers can make a difference in the relevance and commercial viability of the innovations. For example, a Singapore-based film producer or creative director in an advertising agency would find it more difficult to produce something that sells well in the Chinese market. A Singapore-based medical research scientist on the other hand, may not be as handicapped since the product has a much more "global" appeal. In the latter, as long as the local demand is sophisticated and cosmopolitan enough to serve as a first test for the product's viability in the global market, being in Singapore can be as good as being in any major city in the world in the latter case.[33]

Wong et al (2004 b) confirm such a view. As the authors noted, "More than one interviewee has pointed out that many creative contents tend to be localized/culture-bound and less easily globalized compared to technological products, and hence such firms feel greater limitations by the small domestic market of Singapore." They further noted, "The cultural fragmentation of Asian content markets add further to the constraints of operating in Singapore

[33] Some have argued that Singapore has comparative advantage in "fusion" culture, combining the East and the West, and catering to more Cosmopolitan tastes (see ERC report, 2002). It remains to be seen whether this is indeed the case. So far, most local artistic and cultural productions that adopted such a "fusion" approach have not met with great success outside Singapore.

as a content hub. In contrast, high-tech innovators, while facing similar constraints of small domestic markets, see potential to go global…"

It is not surprising then that in most countries the bulk of the income from the creative content industries is derived from the domestic market rather than export sales. In the US, exports of copy-righted products accounted for only 11% of total sales in 2001. In the UK and Australia, the corresponding figures are 9% and 6.3% respectively.[34]

Social and political constraints

Unlike efficiency infrastructure, innovation infrastructure has a larger lifestyle component. While the development of the physical side of the innovation infrastructure may be constrained mainly by the financial resources that a country has, that of the cultural side has to take place within the parameters of the country's larger political and social objectives. Being a sovereign, multi-racial city-state appears to have imbued policy makers with a deep sense of vulnerability and limited the options available to them. A slow, incremental approach will likely remain the preferred route in any move towards greater political openness. This may put Singapore at a disadvantage compared with some other Asian cities which can adopt a far more experimental approach in setting social limits.

Recent experience appeared to bear out such a cautious approach. Prime Minister Lee Hsien Loong, who chaired the ERC, conceded that the government faced many political and social constraints in its attempt to "re-make" Singapore.[35] Other anecdotal evidence tells the same story. The easing of the bar-top dancing rules, for example, were followed by a list of "what not to do" from the police department. The government also felt compelled to clarify its position on the employment of gays in the civil service and affirmed its basic objection to gay lifestyle, after disclosing that gays are not discriminated in the civil service.

A conservative approach to political and social openness could arguably affect innovation in the creative content industries more severely than the other two segments. Those involved in creative content innovations tend to attach much greater importance to the opportunities of working within a more liberal political and social milieu. Many of them may also define

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[34] See ERC Creative Industries Report, 2002.

[35] Speech at the Economic Society of Singapore in April 2003. A recent speech by Lee at the Singapore Harvard Club (Lee, H L, 2004) setting out the landscape for political opening in the coming years further confirmed the same cautious stance that the government would take.

"critical mass" more broadly to include not just numbers but also "diversity" of the people living in the same neighborhood.

Survey results in Wong et al (2004b) lend some support to such a view. When asked about the difficulty of finding or attracting the right type of individuals to undertake innovation work, 100% of the firms surveyed in the creative content industries said this was a real issue, compared with 89% and 79% respectively for high-tech manufacturing and KIB industries. On what is needed to develop a greater pool of creative talents in the economy, a large number of respondents point to measures that would lead to a society that is less regulated and more tolerant of diversity (56% of respondents).

The change of the premiership from Goh Chok Tong to Lee Hsien Loong on 12 August 2004 appeared to mark a new significant development in the government's approach to openness. Both in his swearing-in ceremony speech and his National Day Rally speech, Lee had asked Singaporeans to be bold and to move away from conventional thinking, promising that his government would make it easier for this to happen and offering the vision of a more "open and inclusive" society.[36] How such a new vision is translated into reality would have a major impact on Singapore's attempt to transform the city into an innovation hub.

VI. Efficiency Enhancement in Singapore's Services Sector

Singapore's economic growth has been driven hitherto by the manufacturing sector, especially the electronic clusters. As part of its efforts to diversify the economic growth base, the ERC recommended that the role of the services sector be substantially enhanced. In particular, it suggested that the city be developed into a regional hub for a number of service industries. Compared with the manufacturing sector, possibilities for commoditization in the service sector are smaller. A hub status, once built up, is not easy to break. Hence Singapore's ability to maintain its leadership position for many years in financial services, transport and logistics and healthcare industries. While regional competition may make it difficult for Singapore to command the same premium or to achieve the same robust growth rate in these industries as it did in the past, it would be some time before other cities in the region can generate sufficient agglomeration to completely replace Singapore as a hub. The revamp of the port business by the Port of Singapore Authority (PSA) shows that even in industries where

[36] See swearing-in speech by Lee on 12 August 2004 and national Day Rally speech by Lee on 22 August 2004.

Singapore's hub status appears to be under threat, the outcome of the regional competition is far from obvious.

Following the shocking announcements by two of its major customers, Maersk and Evergreen, to relocate their operational base to the new port of Tanjong Pelapas in neighboring Malaysian state of Johor -- posing a major threat to Singapore port's regional hub position -- the PSA went through a massive restructuring exercise. (PSA recorded a 10 percent decline in container volume and a 9 percent decline in net profit for 2001, which was mainly attributable to the Maersk shift.)

The drastic measures that followed included changes in the top management team, substantial cost cutting (including wage costs), customization of services to its clients, refocusing of its core businesses and new business arrangements with its clients. The moves were painful for many of the employees to say the least. But the upshot is that, after two years, PSA was able to recover roughly the three million TEUs it lost with the departure of the two main shipping lines. Last year, container volume was able to grow at a healthy rate of 7.8 per cent again, to 18.1 million TEUs (see Appendix B for the slew of measures implemented).

Similarly, the deregulation of the financial sector in the past five years has brought about significant consolidation, including mergers of local firms and entry of new foreign firms. This has helped maintain Singapore's hub status in certain activities such as treasury and foreign exchange business, despite the general decline in financial sector activities in the region and competition from other cities to be regional financial centers. Active promotional activities, including new fiscal incentives for fund managers and executive programs to enhance the pool of professionals in the industry, also help strengthen Singapore's position as a regional fund management center.

Like the manufacturing sector and the innovation businesses, the services sector could leverage on the country's strength in efficiency infrastructure. Indeed, combined with the existing hub status in certain services industries, such strength could also give Singapore a "first mover advantage" when making inroads into other service industries such as education, legal services, creative industries etc. Easy access to finance and close connectivity with the rest of the world (as a result of being an air and sea transport, as well as telecommunication hub), for example, are both important in creating agglomeration effects in these other industries.

Given the state of development in the services sector in the region, and given the fast changing technology that makes services increasingly tradable, Singapore could still extract considerable value by merely moving closer to the global efficiency frontiers in the service sector without necessarily engaging in "frontier-pushing" innovations. This could potentially provide an additional source of growth that is significantly less risky than investments in frontier-pushing innovations. In art and culture industries, for example, Singapore may not have the comparative advantage (let alone absolute advantage) in producing the "star" artists (the "real" creative force in the industries), but it can still aim to be the city of choice for the commercialization of the artists' work, leveraging on its strength in efficiency. In many artistic productions, the bulk of the commercialization (e.g. copyrights and financial arrangements, even marketing etc) may be done even before work on the actual creative portion is started. It is not necessary for the two to be carried out in the same city, although there are definite localization economies in the creative sector.[37] Focusing on commercialization efficiency, while less "creative" in the artistic sense, will allow Singapore to share in the growing pie in the creative content industries.

The line between efficiency enhancement and innovation is often blurred, not only in official documents but also in practice. To a large extent, this can be attributed to the less globalized nature of the sector which often requires local adaptation of foreign technology and the way services are delivered. Obviously, in service industries where international best practice is already observed in other regional countries and Singapore's efficiency gap over them is small, innovation would be needed if the city-state is to maintain its regional hub status. This may be the case for banking and financial service industry, logistic industry etc. Success in developing Singapore into an efficient service hub will add further to the economy's strength in efficiency infrastructure and its attraction as a city of choice for creative talent.

More than the manufacturing sector, the growth of the services sector is influenced by changes in the regulatory policy. A lighter regulatory approach could make a big difference. The healthcare industry is one example. In recent years, the growth of Singapore as the regional

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[37] There are many instances of such separation of commercialization and creative work. For example, it was reported in the Straits Times recently that a large number of medical journals and books in the world are published by a Singapore-based company. In some cases, even the creative work itself can be separated into different components, each being carried out in a different location. For instance, Malta has a giant water tank that is apparently the only one of that size and many Hollywood films use it to shoot their underwater scenes.

medical hub has been hampered by a shortage in the supply of doctors and restrictions on the registration of foreign doctors. This has resulted in high private medical costs and an opportunity for some other cities in the region including Bangkok (Thailand) and Malacca (Malaysia) to vie for a slice of the pie. The chain of cause and effect can be traced back to labor planning policy in the form of quotas imposed on medical school enrolment, which was justified on the basis of high training subsidies and the possibility of "supply-induced" demand for medical care. The recent revamp in healthcare policy in Singapore, with particular emphasis on cost reduction, represents a response in this direction. But more fundamental changes in rules regarding the quotas on medical doctors could make a difference.

Developments in the education sector provide another example. The government has embarked on a two-track effort to transform Singapore into a regional educational hub ("Boston of the East"): it is allocating a large amount of resources to the R&D efforts in the tertiary educational sector to enhance its research and innovation capacity; at the same time, it has liberalized rules and regulation governing the operation of the industry at other levels. The first track of activities is "frontier pushing" in nature while the second track is more oriented toward "efficiency-enhancing".

The efforts to boost the research capacity at the universities seem to be driven by the belief that an educational hub has to be anchored by a few world class universities producing frontier research. To this end, various Government grants were given to set up joint research centers between the local and reputable foreign universities to fund collaborative projects between them. Faculty's workloads and evaluation are restructured to give greater weight to research than teaching. More resources are also channeled to specific areas of study seen to be closely linked to the government's blueprint of an innovation-based economy: life sciences, entrepreneurial studies, communications etc.

A key element of this drive for research excellence is the attraction of top researchers from abroad. Recruitment of foreign researchers/faculty members has risen significantly over the past few years. Researchers like Alan Colman, the British scientist who helped clone Dolly the Sheep in 1996, and Edison Liu, formerly head of the US National Cancer Institute, have moved to Singapore to work in a better-funded environment. It has been reported that a mere 8.2 per cent or 160 of the 1,930 researchers in government research institutes are Singaporeans with

PhDs.[38] Many of the foreigners have also been appointed to leadership positions in the three universities to help map the research directions for the institutions.

At another level, rules and regulations regarding granting of licenses for private educational institutions, programs that can be offered and intake of foreign students have been rapidly liberalized. This is aimed at building up a critical mass of educational service providers to cater to the rising demand in the region for quality education at all levels, from secondary school to tertiary and post-graduate levels. Educational service providers at these levels clearly would not be competing in innovations and frontier-pushing activities, but in their abilities to provide services "closer to the frontiers" than their competitors in the region. Singapore's attractiveness as a city to pursue such education is arguably helped by its strength in efficiency infrastructure in general e.g. pleasant and clean living environment, good transport system, good communications system etc.

While it may be too early to judge the final outcome of this endeavor, early evidence seems to suggest that the latter efforts (i.e. efficiency-enhancing) are turning out better than the former (i.e. innovation-based). More than five years of efforts have not brought about a significant change in the ranking of the local universities in world class research output. Instead, in areas outside the hard sciences, especially in arts and humanities, there is a sense that by forcing the researchers to measure their research output to benchmarks set in the US and Europe, the policy has resulted in alienation of the research community from local issues and rendered much of the research output irrelevant to the Singapore economy/society.

On the other hand, the last few years have seen a dramatic jump in the number of educational service providers and educational business in general. Australian and British universities have through local agents, been the largest beneficiaries of such a development. Twinning programs or distance-learning programs continue to grow over the years. A number of top-tier American and European business schools and medical school have also set up campuses or programs in Singapore, providing post-graduate education for students both in Singapore and in the region. In 2007, the University of New South Wales will open a Singapore campus with a capacity for 15,000 students to offer both undergraduate and postgraduate studies.

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[38] See reports in **http://straitstimes.com/education/story/0,1870,182842,00.html**.

A study by Wu (2003) shows that between 1998 and 2002, for example, a total of 38 private educational institutions offering certificates, diplomas, bachelor degrees, postgraduate degrees or professional courses were set up, accounting for 25% of the total number of such institutions in Singapore**.** In fact, about half of all such institutions were set up within the last 10 years. On average, each such institution employs 31 workers and has a operating revenue of S$2.7 million. The number of graduates from these institutions has increased dramatically over the past three years. In 2002 alone, some 40600 students graduated from these institutions. In the same year, the total enrolment was 114,500. The majority of the graduates was in the field of business administration (56%), information technology (20%), and fine and applied arts (6.0%).

In terms of contribution to GDP growth and enhancing Singapore's status as an educational hub, the efficiency-enhancing programs play as large a role (if not larger) as frontier-pushing programs. Enlarging the width of the education service industry has other spillover benefits on the economy. The school system, from primary up to the post-graduate level, has become an increasingly more important and useful channel to attract creative talents from neighboring Asian countries.

VII. Effectiveness of the Supply-Push Approach

It is too early to conclude how Singapore might emerge from its efforts to grow the innovation business. Even in the segment where its perceived comparative advantage is the strongest i.e. high-tech manufacturing innovation, the initial evidence has been mixed. The number of individuals involved in R&D work has increased significantly over the past few years, in large part because of the inflows of foreign researchers. But how this will translate to greater output remains to be seen.

Over the past three years, there was also a significant increase in the number of patents filed in Singapore (see Table 2). However, most of the patents were filed by non-Singapore residents (e.g. 7,340 out of 7,580 in 2002). This is a far cry from other Asian economies. In Taiwan, for instance, domestic residents filed 24,846 patents in 2002 compared with 20,196 patents filed by foreigners. The trend is similar for trademark registration. It is not clear if the new innovation policies have had any major impact on innovation by local companies. Similarly, despite the large amount of resources put into efforts to encourage entrepreneurial activities in the economy, including the appointment of a junior minister to lead the project,

Singapore's ranking in the Global Entrepreneur Monitor actually fell in 2003. It was ranked 15th in a group of 22 OECD/East Asian countries, compared with 11th a year earlier.[39]

Table 2 Number of patents in Asian countries over time

Country	1995		1996		1997		1998		1999		2000	
	Dom	Foreign	Dom	Foreign	Dom	Foreign	Dom	Foreign	Dom	Foreign	Dom	Foreign
Singapore	20	1730	30	3300	20	3100	30	2360	50	4360	110	4980
Japan	94,804	14,296	187,681	27,419	129,937	17,749	125,704	15,744	133,960	16,099	112,269	13,611
South Korea	12,512	5,937	16,516	8,195	24,579	10,082	52,900	17,000	62,635	19,321	34,894	12,006
Taiwan	20,717	8,990	19,410	10,059	19,551	9,805	16,417	8,634	18,052	11,092	23,737	14,928

Sources: Websites of patent offices of respective countries

There are a few questions on the effectiveness of the strategic supply push approach that may deserve closer examination. They revolve around the perceived comparative advantage that the city-state economy has and how resources are being spent to promote innovation in various sectors.

Diffusion of efforts?

Reflecting the holistic approach it embraces in the new innovation policy, the government appears to be targeting a wide range of innovation businesses. However, given the country's comparative advantage discussed above, it may make more sense to focus on innovation in the high-tech manufacturing sector, an area in which it has already built up a certain capacity for innovation. There are good reasons for a greater concentration of resources. To capitalize on the increasing returns and agglomeration effects in innovation activities, deeper specialization is often necessary. Investment in any particular industry must be sizeable enough for increasing returns to kick in. A diffused approach may not be effective in the end.

In this regard, there should be a clearer distinction in the services sector (including the KIBs) between efforts to push the efficiency closer to the frontier and efforts to expand the frontier itself. As noted above, there remains considerable scope for efficiency improvement in various service industries. Doing so not only helps to diversify the sources of growth in the economy, but also enhances the city's attractiveness as a total business environment. Investment

[39] See Wong et al, 2004a.

in infrastructure and training for efficiency enhancement however should not be confused with those for frontier-pushing innovations. The incentive structure and the resources required are not necessarily the same.

As a small, sovereign city-state economy, however, Singapore may face some difficulties in the pursuit of specialization. Concentration of resources in a few industries in accordance with the economy's perceived comparative advantage may require a lot more winner-picking and entail more risks than what the government is comfortable with. "Over-specialization" in production could result in growth patterns which may be too volatile for a small city-state. Compared with other innovative hubs like New York, Boston or London, which are cities within a big economy, supported by a large hinterland, Singapore's appetite for "specialization risk" is limited by its size and the consequent sense of vulnerability. Already, "over-reliance" on the electronic industry has led to much wilder swings in GDP growth in Singapore in recent years. The growth path could be even more volatile if the economy were to put its bet on a handful of innovation-driven businesses. In this context, Singapore does face more constraints than its potential rivals in the region such as Hong Kong, Seoul and Shanghai in terms of the strategy it can pursue and the risks it can take.

A venture capitalist approach in innovation investment?

To a certain extent, the Singapore government's approach toward investment in innovation businesses may be likened to that of a venture capitalist. It is willing to spread its resources over a wide range of industries, with the understanding that only a certain fraction of the investments will bear fruits. Which particular investment succeeds ultimately will be determined in the market. To compensate for its limited insight in the working of the market forces, the government often tries to rope in private sector participation, both to share the investment risk and to provide the discipline needed to guide and develop the business. In the Bio-polis, for example, the government builds the general infrastructure. But at least some of the actual investments in R&D are expected to be undertaken by private sector companies, either solely or jointly with the government.

In theory, the government could mitigate the risk it faces by encouraging as much private sector participation as possible and by monitoring the performance of its investments closely and frequently. If a project fails to attract any meaningful private sector participation, it should lead

to rethinking its ultimate success/viability. The government could progressively increase its stake in a particular industry if the industry shows promise of growth and competitiveness. Alternatively, it could exit the industry altogether if the project fails to take off after a certain point.

Critics of the strategic supply-push policy however remain skeptical about the likely outcome of the approach. To begin with, it is not always possible to have private sector participation. The gap between public returns and private returns may not always be bridgeable. Even in cases where private sector participation is present, the government, as the majority shareholder, quite often ends up making the important decisions. Its track records on such matters have been mixed so far. The handling of the Suzhou Industrial Park project, both in terms of the initial investment and the timing of the exit, for example, was controversial. More recently, remarks by the CEO of the One-North project also raised some concerns. Responding to a question by reporters on what the government would do if the S$15 billion One-North project were to fail, the CEO replied, "Failure is not an option". Clearly, there is a difference between private returns and social returns and One-North may be expected to play a larger "social" role than that of a pure private infrastructure provider. But the answer might have revealed the mindset of at least some officials driving and implementing the policy on innovation in Singapore. As a commentator asked, does the answer suggest that, if the project did not measure up to initial targets, more resources would be pumped in to it salvage it? And where would the process stop?[40]

To be sure, it may not be completely fair to measure the success of the policy on the records in specific industries. Some casualties are inevitable in any practice of "winner-picking", so it is not surprising that Singapore has had its share of such casualties over the years in different industries. Arguably, the strategy can be justified as long as the overall performance of the policy, over a longer period of time, measures up to expectations. To some extent, this has been the case indeed. As can be seen in Table 3, the contribution of productivity growth to overall GDP growth has improved in more recent years. So has the contribution of TFP growth within overall productivity growth.

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[40] See comment by Lee Han Shih, NewPaper, October 2003.

Table 3 Singapore's Total Factor Productivity Record

Contribution to Changes in GDP and Productivity

Indicator	1993-1998		1998-2003[p]		1993-2003[p]	
.	(% per annum)					
Changes in GDP	6.7	(100)	3.4	(100)	5.1	(100)
Attributed to:						
- Productivity	1.9	(29)	2.6	(75)	2.2	(44)
- Employment	4.8	(71)	0.9	(25)	2.8	(56)
Changes in Productivity	1.9	(100)	2.6	(100)	2.2	(100)
Attributed to:						
- Capital Intensity	2.0	(105)	2.1	(84)	2.1	(93)
- TFP	-0.1	-(5)	0.4	(16)	0.2	(7)

Source: Singapore Department of Statistics website
P - preliminary

Whether this lends support to the venture capitalist approach is not immediately obvious, however. An interesting comparison may be made with the experience of Hong Kong. In contrast to Singapore, the Hong Kong government has adopted a much more hands-off approach in innovation policy. It does not take the same kind of risk associated with "winner-picking". Neither does it invest heavily in frontier-pushing innovation. By and large, it appears to be content to let the private sector lead the way and create value wherever it sees opportunities. This may not make Hong Kong a world leader in innovation or technology creation. Indeed, in most cases, Hong Kong businesses tend to create value out of existing technology and business practices. If the Singapore approach is likened to a venture capitalist in the private equity market, the Hong Kong approach may be compared with portfolio investment in the public market.

Yet, it is not at all clear that the Hong Kong approach has resulted in poorer performance for the economy as a whole. It does not seem to have emerged worse than Singapore in the various studies on productivity growth. In the studies by Young cited earlier (Young, 1992; 1995), Hong Kong TFP was found to have grown 2.3% annually compared with Singapore's 0.2% during the period 1966-1991. A more recent study comparing the productivity levels in Asian economies painted a similar picture (see Ong, 2002). The author noted that from 1973 to 1999, Singapore's productivity level consistently stayed below that of Hong Kong, although the gap has narrowed in more recent years. In 1975, for example, Singapore's overall productivity

level was only 87% that of Hong Kong. The figure dipped further in the 1980s. It has risen steadily since then. By 1999, the figure climbed to 90% albeit still below par.[41] While Hong Kong's records on industrial innovation may not be comparable with that of Singapore, it nevertheless impresses with its creativity in certain niche areas such as the performing art industries. Hong Kong's film and music industry, for example, is generally acknowledged to be well ahead of many other countries in Asia, especially among the Chinese-speaking region.

How much innovation infrastructure is necessary?

Our discussion so far suggests that within the new urban growth framework a la Florida, the main economic value in Singapore of some of the innovation infrastructure, especially the social and cultural elements (e.g. the promotion of a thriving artistic community), does not lie in the direct contributions they make to GDP. Rather, the value is seen in the supporting role it provides in building an environment conducive to innovation. But how much of such infrastructure is eventually needed?

Given the strong "strategic" orientation of the government approach in dealing with the regional competition for creative talents, there are inevitable questions about the likelihood of "over-investment" in innovation infrastructure. "Nash" equilibrium in such a competition typically results in "over-investment" in capacity. What constitutes an optimal level of investment is often difficult to decide. For example, how important a role does the Esplanade play in this competition? Could the resources needed to build and maintain the Esplanade have been better used elsewhere?

There should be a more transparent way of evaluating the costs and benefits of such investments. How such evaluation should differ from other forms of social infrastructure investment should also be more clearly spelled out. There are nevertheless reasons to argue for adopting a broader perspective in such evaluations. Firstly, given what we said about the importance of the cross-fertilization and mutual stimulation of different types of innovative people, a minimum level of general innovation infrastructure is needed to foster and deepen the innovation culture in the whole economy. The value of innovation infrastructure should be

[41] Singapore's performance was much poorer compared with the OECD countries. In 1975, Singapore's productivity level was 35% and 47% that of the US and average OECD countries respectively. In 1999, the corresponding figures were 71% and 85% respectively.

measured by its impact on the economy's overall innovative capacity, rather than the successful growth of a select group of industries.[42] Thus, while it may be necessary to set targets for the growth of the creative industries,[43] the benefits of investing in the necessary infrastructure for creative industries should go beyond such direct contributions.

Secondly, innovation infrastructure should not be viewed merely as an investment good. It is also an important consumption good that helps improve the quality of life for all residents, regardless of whether they are part of the innovative sector. This aspect of innovation infrastructure differentiates it from other efficiency and industry-specific infrastructure and greatly reduces the potential of "over capacity". The Esplanade is a good example in this regard. Including consumption as part of the objectives of infrastructure investment will raise the level of investment that is considered "socially optimal", if social optimality for this category of goods can ever be quantified.

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[42] See Stern et al, 2000, for a summary of the various determinants of a country's innovative capacity.

[43] In the report on creative industries (which include arts and culture, design and media), for example, the ERC set the target of having the industries contribute 6% of GDP by 2012 (from about 3% in 2000), and provide employment for 5-7% of the national workforce.

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Appendix A: Internal and External Conditions for Innovations

Intrafirm determinants of organizational innovations

In a survey of literature, Wan et.al. (2003) noted the internal environment favorable to the survival of new ideas and innovations in an organization include (i) frequent internal communications, (ii) decentralized structure, (iii) organizational resources, (iv) belief that innovation is important and should be supported and rewarded, (v) willingness to take risks and (vi) willingness to exchange ideas. Of the list of six determinants, it would appear that the government through tax and other financial incentives would be able to provide incentives for firms to increase the organizational resources available for innovation. The other five determinants would depend much on the leadership and the prevailing culture within the firm, as well as the external environment -- to the extent that the external environment affects the internal culture or values of the firms.

The external environment for innovation and creativity

Baumol (2002) lists the following as amongst the most important business conditions for technological innovation: (i) oligopolistic competition among large, high-tech business firms, with *innovation rather than price serves as the prime competitive weapon*; (ii) routinization of innovation to minimize the uncertainty of the process; (iii) incentives for productive entrepreneurship rather than innovative rent seeking behaviors; (iv) the rule of law; and (v) markets for technology selling and trading. As the above are all features of a capitalist or free market economy, Baumol argues for the free enterprise economy as the best system to foster innovations.

Baumol's analysis is undoubtedly US-centric and takes for granted the existence of laws, institutions, market size and human capital that serve to facilitate innovation. Other conditions would include (i) adequate human capital (ii) society's tolerance for learning through failure; (iii) bankruptcy laws which do not excessively penalize business failures; (v) ease of communications and travel for the dissemination of ideas; and (iv) domestic markets that are sufficiently large to support oligopolistic product competition. Moreover, as technological innovation depends on spillovers facilitated by networks of firms and individuals, the existence of a sufficiently large localized industrial cluster is a necessary condition for specific types of R&D activities.

Another strand in the growth literature considers the influence of economic freedom and political freedom on economic growth. A survey of the empirical literature by Wu and Davis (2003) found economic freedom to be a robust variable in explaining economic growth and development. The empirical results on the influence of political freedom on economic growth were conflicting. Mahmood (2003) however makes a distinction with regard to different stages of the developmental process. Using conceptual models of technological imitation and innovation, Mahmood shows that a government can spur economic development through centralization of economic and political control. However, as the economy approaches the technological frontier, the range of choices narrows. Political and economic freedoms are necessary at this stage as technological innovation depends on spillovers facilitated by networks of firms and individuals, rather than on centralized planning.

Appendix B: What PSA Did to Regain Competitiveness

Focus on Core Customers

- Cut prices for one year from July 1, 2002. 10% less for laden boxes and 50% for empty boxes.
- Customised contracts to meet different needs.
- Segmented the markets and gave incentives.
- Closer link with operators to consolidate feeder network.

Reset Costs

- Reduced headcounts by 800 (12% of workforce) in 2003 and cut wages by up to 14% for those staying on
- Cut non-wage costs by improving productivity, enlarging jobs and deploying staff more flexibly
- Introduced greater wage flexibility tied to the volumes and performance of the business

Refocus on Core Business

- Divest all non-terminal activities e.g. stakes in property, the cruise, exhibition and cable car business, and the Changi International Airport Services (CIAS)
- Refocus on core terminal business at home and abroad.

Anchored Main Lines

- Changed its business model to meet customers' needs.
- Went into a milestone partnership with Cosco to run joint-venture berths in Singapore, PSA's home base; to retain customer loyalty

Working Closer with Unions

- More consultations with unions to secure support for restructuring exercises